

Perioperative Nutritional Support by a Multidisciplinary Team for Patients with Esophageal Cancer

Hiroya Takeuchi*, Ryoma Haneda, Eisuke Booka

Department of Surgery, Hamamatsu University School of Medicine

*Corresponding author: Hiroya Takeuchi, takeuchi@hama-med.ac.jp

Copyright: © 2023 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract

Esophageal cancer surgery is a highly invasive procedure, and a multidisciplinary team approach is crucial for safe perioperative management of patients without complications. The Hamamatsu Perioperative Care Team (HOPE) has been established, which is a multidisciplinary team that promotes safer and more reliable perioperative care. HOPE has proven effective in preventing post-esophagectomy pneumonia and weight loss. Currently, HOPE is being developed through comprehensive staff training and the implementation of innovative features, including treatment diaries and wearable fitness trackers. This article explores the benefits of collaborative medical practices and the future objectives of HOPE, whilst also examining the progress of perioperative team medicine in Japan.

Keywords

Esophageal cancer
Team medicine
Perioperative management

1. Introduction

Esophageal cancer is the sixth leading cause of cancer-related death and has a dismal prognosis. Squamous cell carcinoma accounts for the majority of esophageal cancer cases in Japan. According to the 2022 Guidelines for Esophageal Cancer, the preferred treatment for operable advanced esophageal squamous cell carcinoma is subtotal esophagectomy following preoperative chemotherapy^[1]. Subtotal esophagectomy is a highly invasive surgical procedure often involving the cervical, thoracic, and abdominal regions, which

carries a significant risk of postoperative complications. These complications can result in nutritional disorders, decreased quality of life (QOL), and poor long-term prognosis, and the prevention of complications remains a pressing challenge^[2]. Minimally invasive surgical procedures, such as thoracoscopic and mediastinoscopic surgeries, as well as robot-assisted surgery, have been extensively employed and are expected to be effective in preventing postoperative complications^[3]. However, multidisciplinary treatment, which can include surgery, chemotherapy, and radiation therapy, has also been

reported to be effective, and it is crucial to maintain nutritional status during the treatment process ^[4]. However, advanced esophageal cancer frequently leads to impaired transit and significant weight loss. Furthermore, patients who have undergone subtotal esophagectomies are susceptible to malnutrition due to the extended period of time it takes for them to improve their food intake.

Enhanced Recovery After Surgery (ERAS)/Fast Track Surgery has been adopted in the surgical field to facilitate swift recovery after operations. The ERAS protocol was proposed by the ERAS[®] Group of the European Society for Clinical Nutrition and Metabolism (ESPEN). Its primary objective is to prevent postoperative complications, shorten hospital stays, and improve safety. This goal is achieved by implementing items that enhance postoperative recovery in a multidisciplinary manner. The ERAS concept is increasingly gaining traction in Japan, with growing emphasis on the need for a comprehensive perioperative management team comprising not just physicians, but also dentists, nurses, rehabilitation specialists, and other healthcare professionals.

ERAS has undergone clinical studies in esophagectomy and proven to reduce respiratory complications, suture failure, and length of hospital stay ^[5]. The 2022 edition of the Guidelines for the Management of Esophageal Cancer includes a “Perioperative Management and Clinical Paths” section on perioperative management, which includes the inquiry “CQ29: Do you advise preoperative rehabilitation for esophageal cancer?” A systematic review, both qualitative and quantitative, was carried out and it was concluded that “preoperative rehabilitation is weakly recommended to prevent complications after surgery for esophageal cancer” ^[1]. The techniques and facilities for perioperative nutritional therapy and rehabilitation vary significantly, and the involvement of a perioperative management team is deemed beneficial. In this article, we examine the outcomes achieved by the perioperative management team in our hospital,

as well as the challenges that lie ahead in the field of team medicine. Additionally, we delve into the history of perioperative management teams in Japan, thereby providing a comprehensive overview of this critical area of medicine.

2. Changes in perioperative management teams in Japan

Perioperative management teams are expected to enhance patient safety by sharing information and exchanging opinions throughout the organization. This takes advantage of the unique characteristics and strengths of each medical staff member. In 2008, Shirakawa *et al.* established the Perioperative Management Center (hereafter referred to as PERiO) and implemented a multidisciplinary team intervention for patients with esophageal cancer during the preoperative outpatient period ^[6]. Patients electing surgery undergo instruction in smoking cessation, physical ability and condition assessment, exercise guidance, and oral care by the dental department prior to surgery. Following surgery, patients receive continued oral care along with feeding and swallowing rehabilitation, respiratory physiotherapy, exercise therapy, and assistance with basic activities ^[6]. As a result of the introduction of PERiO, the length of hospital stays after esophageal cancer surgery was reduced, as was the number of days until patients were able to start walking. The introduction of PERiO significantly reduced adverse events during preoperative chemotherapy ^[4], as reported by Watanabe *et al.* in their establishment of the Perioperative team at Cancer Institute Hospital (referred to as PeriCan) in 2013. PeriCan provides preoperative guidance on cessation of alcohol and smoking, oral care, and postoperative early weaning, rehabilitation, evaluation of swallowing function, and dietary guidance. The short-term results of a comparison of 113 patients who underwent esophagectomy before and after PeriCan revealed a significant reduction in postoperative

complications, particularly postoperative pneumonia^[7]. Additionally, a noteworthy reduction in postoperative pneumonia was noted in patients with postoperative recurrent nerve palsy following the implementation of PeriCan, indicating the efficacy of perioperative team intervention even in high-risk aspiration patients^[7].

3. Perioperative medicine team at our hospital

In April 2017, the Hamamatsu perioperative care team (hereafter referred to as HOPE) was established with the aim of ameliorating safe perioperative management, long-term prognosis, and quality of life of patients^[8]. HOPE comprises physicians, nurses, rehabilitation specialists, and the dental department, and works in collaboration with the nutrition support team, infection control team, and palliative care team (**Figure 1**). Esophageal cancer patients undergoing surgery receive intervention from HOPE staff starting at their first outpatient visit. Patients are advised to cease smoking and drinking for at least one month. Additionally, oral assessment and care are provided by the dental department^[8]. Rehabilitation professionals assess the patient's swallowing abilities and fundamental physical fitness including walking speed, grip strength, and knee

extension muscle strength. Cardiopulmonary exercise stress tests are implemented, followed by instruction on suitable aerobic and resistance exercise regimens. Concurrently, patients receive respiratory physiotherapy that includes the use of an incentive spirometer to facilitate expectoration. Furthermore, the dietary intake of the patient is thoroughly surveyed by a dietician, alongside pertinent body measurements encompassing upper arm circumference, sub-triceps fat thickness, brachial muscle circumference, and lower limb circumference, and body composition analysis utilizing Inbody (Tokyo, Japan) for a comprehensive preoperative evaluation of nutritional health^[8]. If nutritional intake is suboptimal, we advocate systemic nutrition support through oral nutritional supplements (ONS). For patients suffering from transit difficulties, we aim to offer intestinal nutritional support, including ONS-based nutritional support and percutaneous endoscopic gastrostomy, where possible. The HOPE conference facilitates sharing of preoperative assessments from each department and allows for discussion of the necessary surgical interventions. From 2019 onwards, in order to encourage patients to proactively engage in pre-surgical rehabilitation, patients are provided with a diary for recording their daily nutritional intake, physical activity,

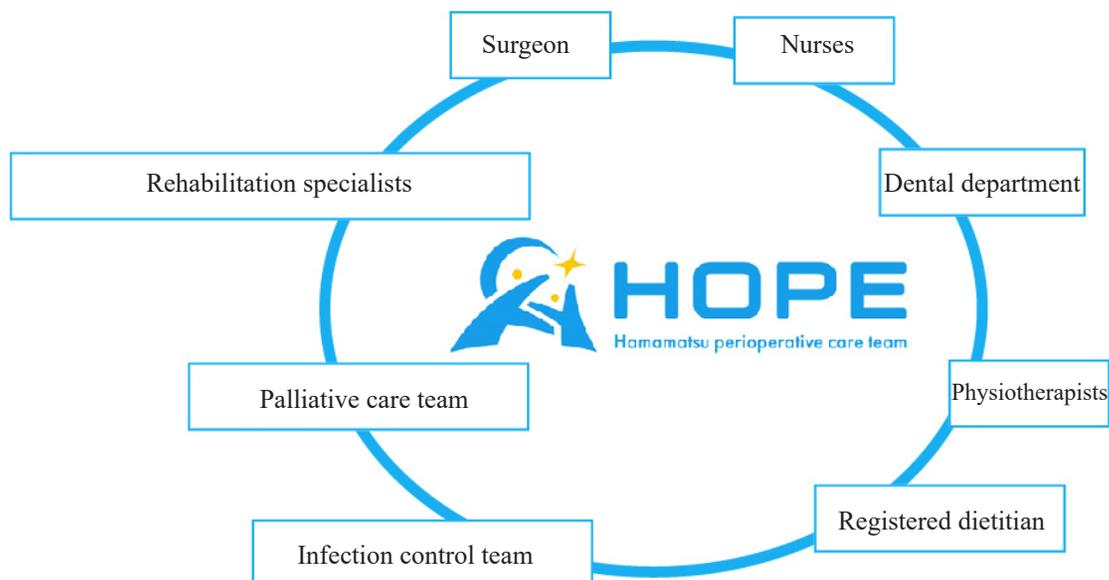


Figure 1. Composition of HOPE

respiratory rehabilitation sessions, teeth brushing sessions, and subjective symptoms. In addition, patients wear a wearable fitness tracking device (WFT) to record their heart rate, step count, physical activity, calorie intake, and sleeping habits^[9]. The WFT is anticipated to increase motivation for postoperative rehabilitation by providing a visual representation of physical activity levels.

After the surgery, pain management is administered while encouraging early mobilization. The technique of gastrointestinal fistula (either gastrointestinal or jejunostomy) is performed on all patients, and early enteral nutrition is initiated on the day of the procedure. Enteral nutrition is gradually increased to a target of 1,200 kcal/day on the fifth day after surgery while closely monitoring abdominal symptoms, starting at a rate of 10 kcal/h. On the seventh day following the operation, the patient was switched to semi-digestible formulas that are rich in n-3 fatty acids due to concerns about deficiency of essential fatty acids. Typically, oral intake begins after the seventh postoperative day; however, a rehabilitation specialist evaluates all patients for recurrent nerve palsy and swallowing function before commencing oral intake (contrast swallow and endoscopic evaluation of swallowing). Upon initiation of oral intake, patients receive instructions on the appropriate position to assume while eating to prevent aspiration. Gradual reduction of enteral nutrition occurs concomitantly with oral intake. However, if oral intake, including ONS, proves inadequate upon discharge, patients will continue enteral nutrition at home. After being discharged from the hospital, the patient receives follow-up care at outpatient visits in

collaboration with rehabilitation specialists. Physical fitness is specifically assessed at 1, 3, 6, and 12 months post-surgery, while physical function is evaluated as required. Simultaneously, an outpatient nutritionist provides nutritional counselling, assesses dietary intake in the patient's residence, and advises on oral intake, introduction of ONS formulations, and enteral nutrition management whilst considering the patient's lifestyle^[8]. The treatment diary and WFT are implemented from the onset of the intervention until one month after hospital discharge^[9].

4. Changes after the introduction of perioperative management team

To assess the effects of the implementation of HOPE on postoperative complications, 125 patients diagnosed with esophageal cancer and esophagogastric junction cancer who underwent subtotal thoracic esophagectomy and gastric tube reconstruction at Hamamatsu University Hospital in the years 2014–2018 were divided into the pre-HOPE group (n = 62) and HOPE group (n = 63), and their short-term postoperative outcomes and changes in nutritional indices were compared^[8]. The HOPE group showed a significant decrease in postoperative complications compared to the pre-HOPE group (6.0% vs. 19.0% respectively, $P = 0.027$). Additionally, the HOPE group displayed a lower incidence of postoperative pneumonia of Clavien-Dindo (C-D) grade II or higher compared to the pre-HOPE group (14.0% vs. 29.0% respectively, $P = 0.037$), as shown in **Table 1**^[8]. When divided by the time of pneumonia onset, there was no difference in pneumonia incidence before commencing

Table 1. Short-term postoperative outcomes pre- and post-intervention of perioperative management team

Complications (Clavien-Dindo classification)	Pre-HOPE (n = 62)	HOPE group (n = 63)	P value
Atrial fibrillation (≥ Grade II)	12 (19.0%)	4 (6.0%)	0.027
Pneumonia (≥ Grade II)	18 (29.0%)	9 (14.0%)	0.037
Pneumonia occurring before meal start	8 (13.0%)	7 (11.0%)	0.368
Pneumonia occurring after meal start	10 (16.0%)	2 (3.0%)	0.012

the diet between the two groups. However, pneumonia incidence significantly decreased in the HOPE group after starting the diet (16.0% in the pre-HOPE group compared to 3.0% in the HOPE group, $P = 0.012$) (**Table 1**)^[8]. Subsequently, the weight loss rates before and at 1, 3, 6, and 12 months after surgery were compared between the two groups. The HOPE group exhibited a significantly smaller rate of weight loss^[8]. Additionally, the iliopsoas muscle index was measured from preoperative and 4 to 6 months postoperative CT scans, and the HOPE group showed a significantly smaller rate of decrease^[8].

To assess the impact of treatment diaries and WFT placement, we compared 31 patients in the WFT group with 31 patients in the non-WFT group among a total of 94 patients who underwent subtotal esophagectomy between 2019 and 2021^[9]. We adjusted for relevant covariates using propensity score matching and obtained an average WFT placement rate of 91.8%. A clear causal connection is established between the WFT placement and the patient groups using objective evaluations. Additionally, the conventional format and language nuances are meticulously employed, following larger academic standards. The WFT group had a significantly lower overall postoperative complication rate compared to the non-WFT group, particularly in terms of postoperative pneumonia of C-D grade II or higher, with rates of 16.1% vs. 38.7%, respectively ($P = 0.043$) (**Table 2**)^[9]. Additionally, patients in the WFT group had a significantly shorter postoperative hospital stay, with a median of 22 days versus 29 days in the non-WFT group ($P = 0.012$).

Nutritional indicators at one month after the surgery consisted of serum albumin, with WFT group having a median of 3.9 g/dL as compared to non-WFT group having 3.6 g/dL ($P = 0.013$), serum transthyretin, with WFT group having a median of 24.4 g/dL while non-WFT group having 19.4 g/dL ($P = 0.001$), and prognostic nutritional index^[10], with a median of 46.2 in the WFT group and 42.6 in the non-WFT group ($P = 0.034$). The WFT group had significantly higher indicators (**Table 2**)^[9]. We are currently carrying out a randomized, non-blinded, controlled trial in order to assess the effects of our preoperative short-term nutrition and exercise program (STEP-NEXT) on the enhancement of nutritional status and physical function following esophagectomy.

5. The study of the esophageal cancer team medicine

In May 2019, 144 patients who underwent subtotal esophagectomy and gastric tube reconstruction between the launch of HOPE in 2017 and 2020 were divided into early group ($n = 80$) and late group ($n = 64$) and changes in nutritional status were compared. The study of the esophageal cancer team medicine suggests that the incidence of postoperative pneumonia of C-D grade II or higher was significantly lower in the late group when compared to the early HOPE group (7.8% in the late HOPE group compared to 16.3% in the early HOPE group, $P < 0.01$) (**Table 3**). This finding helps in supporting the effectiveness of delayed treatment approach in reducing the risk of postoperative complications. Weight loss one month

Table 2. Short-term postoperative outcomes with and without wearable fitness tracking device

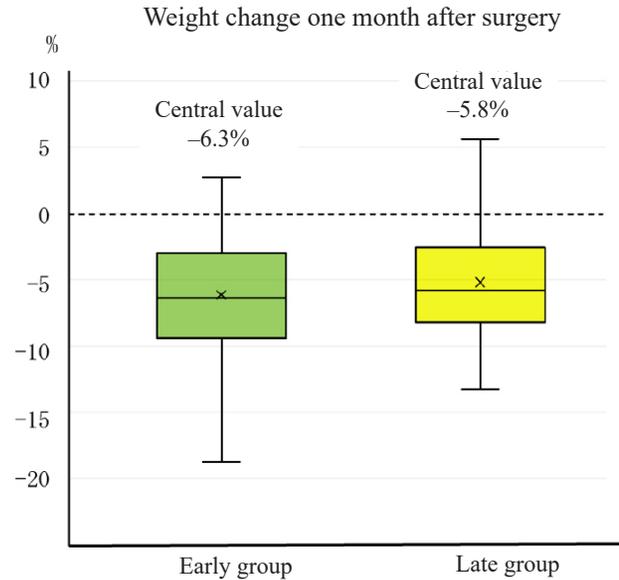
	WFT group (n = 31)	Non-WFT group (n = 31)	P value
Overall postoperative complications (\geq Grade II)	5 (16.1%)	12 (38.7%)	0.043
Pneumonia (\geq Grade II)	0 (0.0%)	7 (22.6%)	0.005
Postoperative hospital stay, days [†]	22 (20–29)	29 (24–36)	0.012
Serum albumin level (g/dL) at 1 month postoperatively*	3.9 (3.6–4.1)	3.6 (3.2–3.9)	0.013
Serum transthyretin level at 1 month postoperatively (g/dL)*	24.4 (21.5–26.0)	19.4 (15.0–22.9)	0.001
PNI [†] at 1 month postoperatively	46.2 (40.8–49.7)	42.6 (37.8–45.9)	0.034

Table 3. Short-term postoperative results before and after HOPE

Comorbidity (Clavien-Dindo classification)	Early HOPE group (n = 80)	Late HOPE group (n = 64)	P value
Pneumonia (\geq Grade II)	13 (16.3%)	5 (7.8%)	< 0.01

after surgery was also lower in the late group compared to the early group (median, early group -6.3% vs. late group -5.8%) (Figure 2). The enhanced postoperative outcomes and nutritional status over time since the inception of HOPE can be traced back to the following factors: reinforced understanding amongst medical professionals from varied departments relating to their respective specialties through frequent discussions, standardization of prophylactic bowel preparation and tube feeding procedures, implementation of personalized diets based on swallowing evaluations, minimization of aspiration risks through a dedicated program, and betterment of nutritional status through employment of nutritional suppositories. The implementation of a treatment diary and WFT may have potentially enhanced the patients' motivation.

It is anticipated that the proportion of older patients with esophageal cancer undergoing surgical procedures will progressively rise as the population ages. Postoperative nutritional status and quality of life of the geriatric population are notably compromised, with rehabilitation of physical functions being a challenging and prolonged process. In addition to ensuring safe

**Figure 2.** Postoperative weight loss rates for early and late HOPE groups

preoperative, intraoperative, and postoperative discharge management, it will be crucial to strive for long-term improvement in the patients' quality of life. This will require the collaboration of a medical team to aid patients in reintegrating into society during both the recovery and remote phases.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Japanese Esophageal Society, 2022, Perioperative Management and Clinical Pathway, in Esophageal Cancer Treatment Guidelines 2022 Edition, Kanehara Publishing, Tokyo, 82–85.
- [2] Booka E, Takeuchi H, Nishi T, et al., 2015, The Impact of Postoperative Complications on Survivals After Esophagectomy for Esophageal Cancer. *Medicine (Baltimore)*, 94(33): e1369. <http://doi.org/10.1097/MD.0000000000001369>

- [3] Takeuchi H, Miyata H, Ozawa S, et al., 2017, Comparison of Short-Term Outcomes Between Open and Minimally Invasive Esophagectomy for Esophageal Cancer Using a Nationwide Database in Japan. *Ann Surg Oncol*, 2017(24): 1821–1827.
- [4] Shirakawa Y, Noma K, Maeda N, et al., 2021, Early Intervention of the Perioperative Multidisciplinary Team Approach Decreases the Adverse Events During Neoadjuvant Chemotherapy for Esophageal Cancer Patients. *Esophagus*, 2021(18): 797–805.
- [5] Low DE, Allum W, De Manzoni G, et al., 2019, Guidelines for Perioperative Care in Esophagectomy: Enhanced Recovery After Surgery (ERAS[®]) Society Recommendations. *World J Surg*, 2019(43): 299–330.
- [6] Shirakawa Y, Tanabe S, Fujiwara T, 2019, Forefront of Perioperative Team Medicine for Esophageal Cancer Surgery. *Journal of the Japanese Society of Gastroenterology*, 116(2): 138–144.
- [7] Watanabe M, Mine S, Nishida K, et al., 2016, Improvement in Short-Term Outcomes After Esophagectomy with a Multidisciplinary Perioperative Care Team. *Esophagus*, 2016(13): 337–342.
- [8] Kawata S, Hiramatsu Y, Shirai Y, et al., 2020, Multidisciplinary Team Management for Prevention of Pneumonia and Long-Term Weight Loss After Esophagectomy: A Single-Center Retrospective Study. *Esophagus*, 2020(17): 270–278.
- [9] Honke J, Hiramatsu Y, Kawata S, et al., 2022, Usefulness of Wearable Fitness Tracking Devices in Patients Undergoing Esophagectomy. *Esophagus*, 2022(19): 260–268.
- [10] Onodera T, Goseki N, Kosaki G, 1984, Indications and Limitations of TPN for Non-Curative Resection and Cough Surgery for Stage IV/V (V is Colorectal Cancer) Gastrointestinal Cancer. *Journal of Japan Surgical Society*, 85(9): 1001–1005.

Publisher's note:

Art & Technology Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.